WEB-BASED GRAPHIC SERVICE REQUEST SYSTEM FOR OPERATION AND MAINTENANCE FOR RESIDENTIAL COMPLEX

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Abstract: This research investigates the feasibility of web technology as a means of handling service requests for delivering high quality service in building operation and maintenance. This research proposes a web-based graphic service request (WGSR) system as a pragmatic solution to the limitations of current computerized maintenance management system (CMMS) processes. Service request process in CMMS was developed as text-based, so that it is hard for ordinary tenants to use. Therefore, when tenants have a problem in a facility, they prefer calling in service requests or going to the office instead of using the internet service request application. The interface allow customers to report environmental problems in the facility, trace their work order progress, view schedules for maintenance, and provide feedback for service online. The WGSR system is an end-user point-and-click graphical interface that allows residents to request service by selecting a problem fixture on a floor plan image.
Keywords: Service request, Computerized maintenance management system, Customer satisfaction, Facility information

1. INTRODUCTION

1.1 Present Status

According to the definition by the International Facility Management Association (IFMA), Facility Management (FM) is a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process, and technology. Process of integrating people, place, process and technology generates information in many fields, such as general facility planning and operations, asset management, maintenance and energy management, real estate management, space planning and management, engineering and construction. One of the strategies dealing with operation and maintenance information is a CMMS. Although CMMS is a good tool to deal with the operation and maintenance of a building, it has been developed for commercial complexes so that it is expensive to install, needs to have an operator, and is hard to adjust to other types of complex. Another problem is that service request process in CMMS has been developed as text-based, so that it is hard for the customer to use. Therefore, when the customer has a problem in a facility they prefer calling in for a service request or coming to the office instead of using the Internet service request application. The maintenance personnel manually enter this oral service request into their system, some times long after the phone call has been made [1]. Through this process, a report can be missed in shuffled papers or be forgotten to be documented. Most building operators obtain corrective maintenance information such as tenant complaints through a lengthy process that provides no feedback to the tenant.

1.2 Significance of Study

This research will help facility managers to decide whether or not the new Customer-centered CMMS has high performance and whether or not they can deliver service efficiently. Clayton et al [2] mentioned in “Delivery of Facility Information to Support Operation Documents” that the phrase “delivery of facility information” has different meanings from different vantage points in the facility life cycle. The study address three phase to delivery of facility information;

1) delivery from consultants to the personnel
2) delivery from the information system to the operations and personnel
3) delivery from the operation personnel to the information system as feedback for quality assurance.

This research addresses one more phase to delivery of facility information from the customer to the information system. From the point of view of an FM department, it can be important that the customer participates in the FM process, because it stimulates the customer interest in the FM process and activities. Moreover, it decreases not only miscommunication among them, but also saves time from favoring digital work orders over oral requests to minimizes redundancies and inefficiencies. The application of this system will provide a way for applying continuous improvement in the FM approach to service requests.

2. METHOD

2.1 Process of Development in the Prototypes

The interface allows the customer to report facility problems, trace work orders in progress, view schedules for maintenance, and provide feedback for service online by using a Graphic User Interface (GUI). A five step model of the prototyping process is illustrated in Fig. 1.

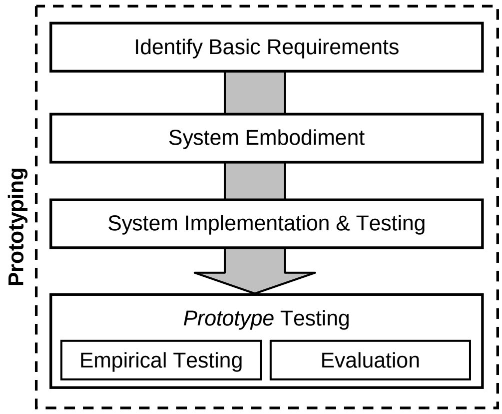

Fig. 1. Process of development in the prototype

The research method consists of the following steps:

Step 1. Identify Basic Requirement

This step identifies the basic needs of users for the system. Three sources of information were used to define and compose the structure of the user interface:

- Historical daily operation and maintenance records.
  What types of requests do residents report? The types and volume of requests will be analyzed. Federspiel [3 ,4] analyzed maintenance records from hundreds of buildings, covering duration of several years in total. His analysis shows that 75% of environmental complaints reported by occupant and recorded in maintenance databases involve thermal conditions [3]. However, the subject of this research will be the occupant in a residential complex and they control the thermal condition on their own, so that type and volume of compliant is different from tenants in office buildings.
- Interview with FM staff
  FM staffs are asked about the communication methods and problems between the customer and FM department, and the process of service delivery such as making the request to work order and performance of the work order. The problem of communication and service delivery will be analyzed.
- Survey with the occupants
  What kinds of problems occur often in their unit? How do they report their problem to the FM department? The satisfaction of service and the relevant information is collected for answering the above questions to support the approach in this stage.

Step 2. System Embodiment

This step defines the relationship about the basic requirements and organizes a hierarch of these for the structure of a database. The Entity Relation Diagrams (ERDs) will be used to show the relationship more clearly. ERDs have three basic elements: entity types, relationships, and attribute. Entity type is a collection of entities (person, place, events, or things) of interest represented by a rectangle in an entity relationship diagram. Attribute is a property of an entity type or relationship. Each attribute has a data type that defines the kind of value and permissible operation on the attribute. Relationship is a named association among entity types. A relationship represents a two-way or bidirectional association among entities. Most relationship involves two distinct entity types [5].

Step 3. System Implementation and Testing

Currently there are two main popular Web servers available, Apache by the Apache Server Foundation on the UNIX system, and IIS (Internet Information Services) server by Microsoft on the Windows system. In the UNIX system, generally PERL (Practical Extraction and Report Language) and PHP (Hypertext Processor) are used; ASP (Active Server Pages) is used in the Windows system as a programming language. Various brands of databases are being used, such as MS Access database, MYSQL server, MS-SQL servers, or Oracle databases. Each database has its own features and characteristics. Usually database selection is based on the size of data, the number of users, and the amount of accessing traffic [6]. Most Internet users use a Windows system for network services. Therefore, IIS server, ASP programming language, and MS Access database were selected to develop the system. Test will be performed first by the developer to fix bugs which occur during the process of entering and retrieving data.

Step 4. Empirical Testing and Evaluation

This step evaluates the system's logical and physical concepts. Residents of Texas A&M University apartments will be chosen for the test group. There are four types of apartment in Texas A&M University apartments (Avenue A, College Avenue, College View, and Hensel). Each apartment has a different floor plan so this will be good for comparison. Residents of College View and Hensel terrace apartments will be chosen for testing due to time limitations.

After the empirical test, a Web survey in the form of a questionnaire will be given to residents to ask about the usefulness of the system. The survey results will be helpful in evaluation of the system and its future development.

3. SYSTEM DESIGN

3.1 The Subjects

Ten residents each in both College View and Hensel apartment complexes were contacted. These residents used the system for approximately fourteen days. A user account was created with the address of each resident. They were instructed to act as if there were problems in their unit (or to remember when they had problems before). They were to log in the Web-page and submit one or multiple service requests. After using the Internet service request system, they were to evaluate the usefulness of the Web-page through a Web survey. Nineteen members of the population submitted sample service requests and seventeen residents participated in the survey questionnaire.

3.2 The Survey Result and Problem Type Analysis

- Communication – Thirteen out of seventeen participants reported their problems by telephone and two of them requested services face-to-face by walking in to the FM office. Nine out of seventeen participants encountered problems in communication with the lease office (Fig. 2).
- Hesitation − Hesitation is the unwillingness to do something, or a delay in doing it, because of uncertainty, worries, or embarrassment. If a customer feels hesitation before asking for service, it is even harder to deliver high a quality service and satisfy the customer (Fig. 3.)

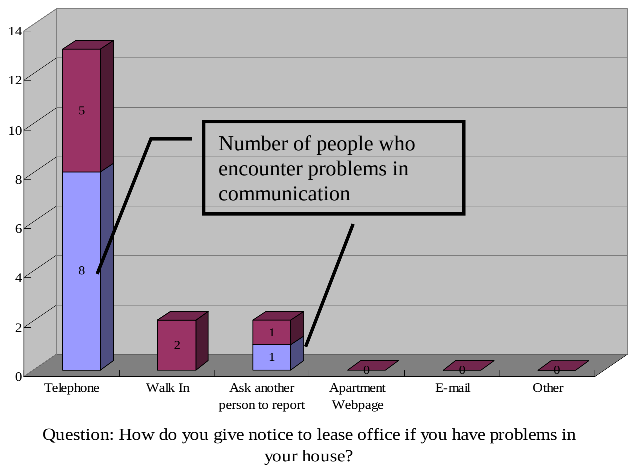

Fig. 2. The way of communication with FM administration

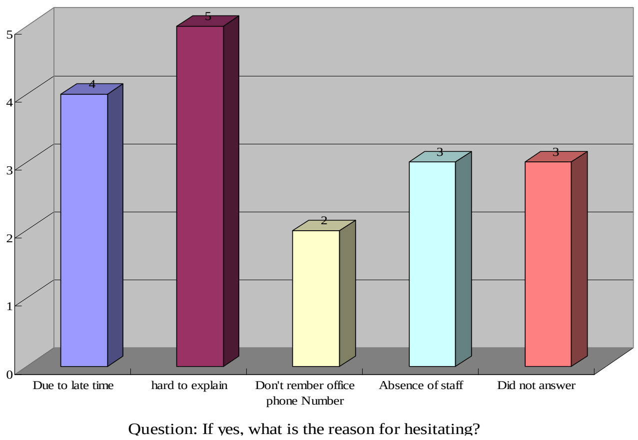

Fig. 3. The reason of hesitation to report

The sixty most common problems reported by residents are analyzed and categorized by the features of each fixture. Otherwise, they can be categorized as miscellanea.

- Sink – faucet leaking, leaking under sink, drain clogged up, disposer broken, overflowing, pop up broken, faucet knob broken, water pressure of faucet high or low, mold, etc.
- Toilet – water pressure of toilet low or high, water leaking from toilet, clogged up, toilet seat & lid broken, overflowing, toilet tank flapper disconnected with lever, toilet tank lever broken, toilet tank fill valve broken, mold, noise, etc
- Bathtub – water pressure low and high, faucet leaking, clogged up, pop ups broken, overflowing, shower head clogged, tub cracked, mold, etc
- Lighting – ballast noise, fluorescent starter fail, switch broken, switch plate replace, noise, smoked, etc
- Window – blind broken, blind wand broken, glass broken, frame stuck , blind stuck, fly net broken, etc
- Cupboard – cupboard broken, cupboard door hinge broken, cupboard shelf broken
- Door – door locked, door hinge broken, doorknob broken, lockset replaced, pest control, mold, etc
- Outlet – outlet plate broken, sparked, smoked, out of power, etc
- A/C & Heater – A/C high or low, Heater high or low, noise, filter replace, etc
- Range – range fan broken, range fan bulb out, range fan filter replace, gas leaking, gas range knob broken, sparked, out of power, oven broken, etc
- Ceiling & floor – cracked, mold, water leaking, etc

The pattern or types of requests are available through interviews with FM staff and the researcher's two years of previous experience as FM staff. This defines the structure of the database system which is called Entity Relationship Diagram (ERD) (Fig. 4). Each room, fixture, and problem types is assigned a unique identification number. A combination of numbers makes one service request. HTML image map tags are assigned for specific areas and fixtures so that system recognizes combinations of numbers for the request. The rest of the database stores user information and information related to user's requests.

3.3 System Embodiment

In reporting, there are three steps for submitting a request. When residents log in the system, the perspective drawing of the floor plan is retrieved from the database. Based on the login information, the database retrieves the different floor plan for where the residents live. Figs. 5 and 6 show different floor plans of apartments.

Most of the residents' apartments consist of a living room, bedroom, kitchen, and bathroom. In the first step, the resident clicks the part of the image where the problem happened. To help the user click the right area, when a mouse hovers over a specific room, the color of the room turns blue by using swap image scripts in Java (Fig. 6). For example, when there is a problem in the kitchen, the resident clicks the kitchen part on the image of the whole unit.

In the second step, the resident clicks the component which has problems. Each room has common items (such as doors, windows, lighting, outlets, etc.) and unique components (such as kitchen range, sink, cupboard, toilet, bathtub, etc.). After that, the image of the selected area magnifies in size to be the same as the previous image of the whole floor plan (Figs 7, 8, 9 and 10).

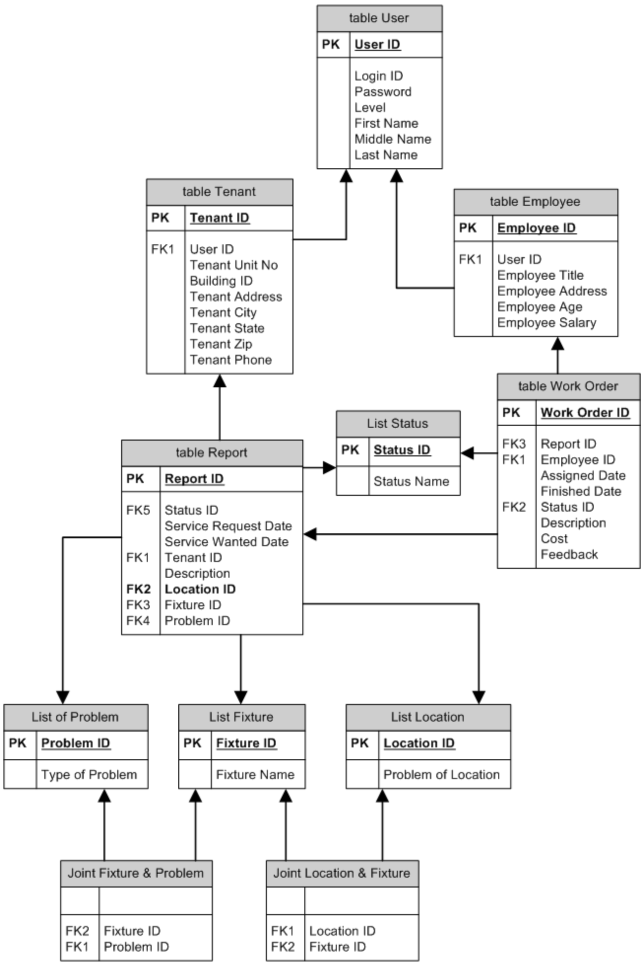

Fig. 4. Entity Relationship Diagram (ERD)

Fig. 5. First page for College View apartment

In Fig. 10, the ASP generates a sentence for the place which resident selected as shown in blue box. In the second step, the resident clicks on the detailed part of the fixture. When the mouse hovers over each fixture on the image, the name of component appears on the image so that the user can select the correct part.

Fig. 6. Step 1 page to submit a new service request

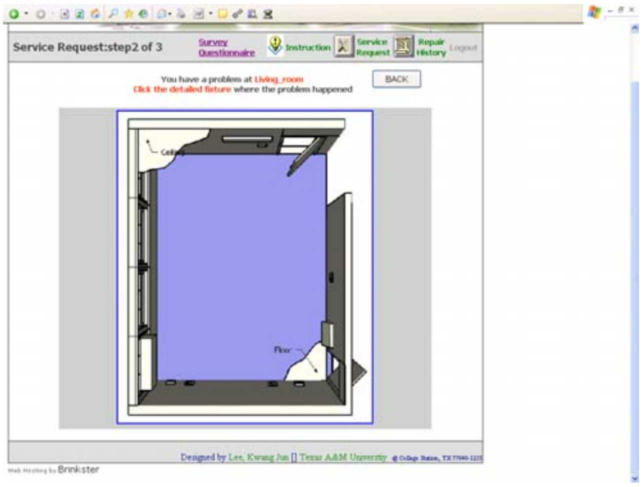

Fig. 7. Image of living room on step 2 page

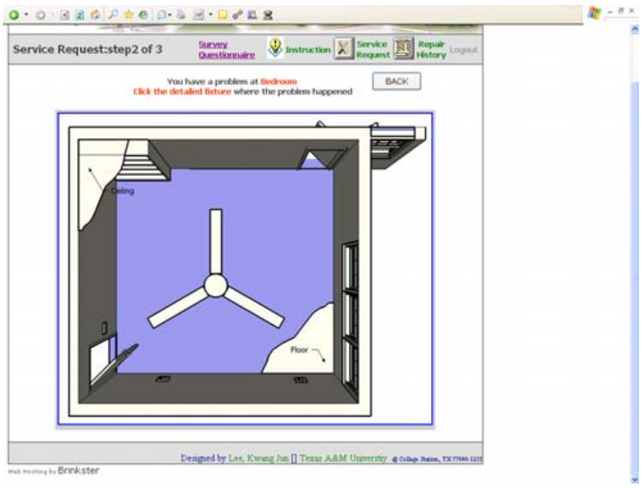

Fig. 8. Image of bed room on step 2 page

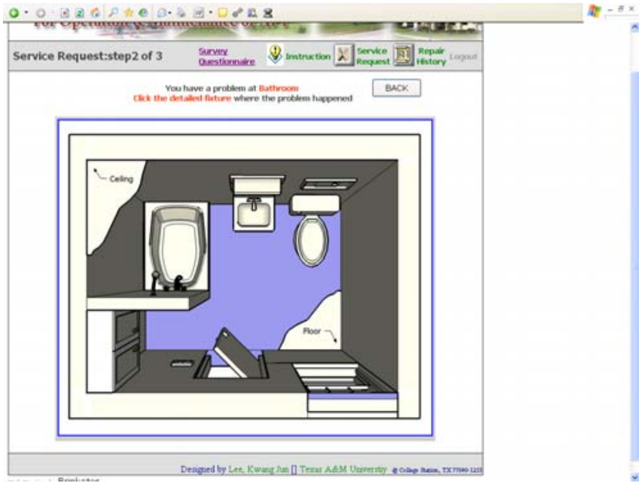

Fig. 9. Image of bathroom on step 2 page

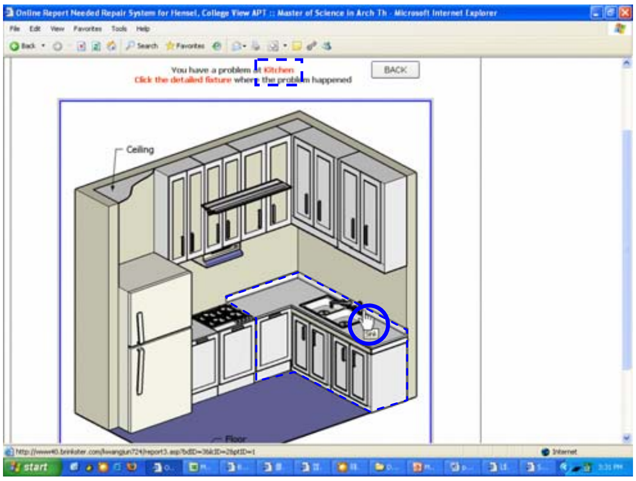

Fig. 10. Step 2 page of service request

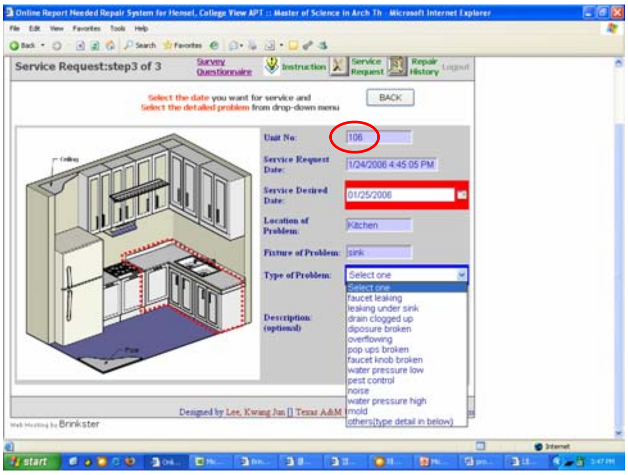

Fig. 11. Step 3 of service request

In the next step, the final form of the service request appears right after the image (Fig. 11). The location and fixture of the problem has already been chosen in the previous stage. Additionally, a red dash-dot layer will be created around the fixture of the problem to help the user recognize the area they selected. The system can do this because it recognizes the identification number of each fixture and it creates a layer for the specific fixture. For the type of problem, the ASP scripts retrieve problem types only related with the specific area and fixture selected in first and second steps. This is possible because the associated table (Joint Fixture and Problem table) has information on which fixture has what kinds of problems. If the type of problem does not appear in the drop-down menu, the resident can select “other” and write down a detailed explanation about the problem in the description box. The administrator can add this problem to the database if the same kinds of problems happen frequently.

Before submitting the service request, a confirmation step appears to make sure the user reports the exact problem correctly (Fig. 12). The user can submit multiple problems one by one after every submission. Fig. 13 shows the end of one service request.

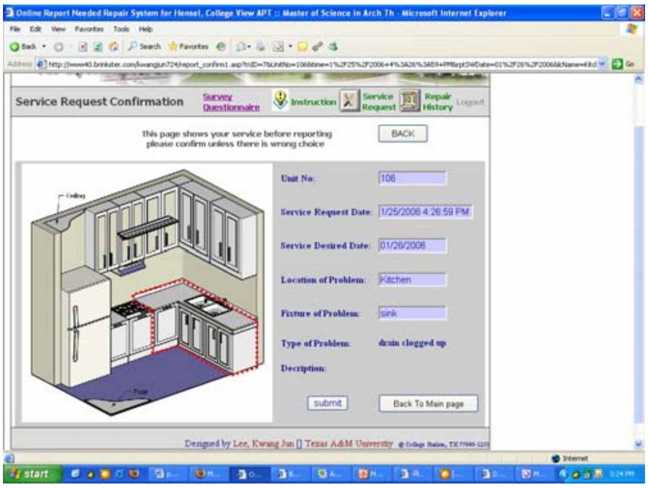

Fig. 12. Service request confirmation page

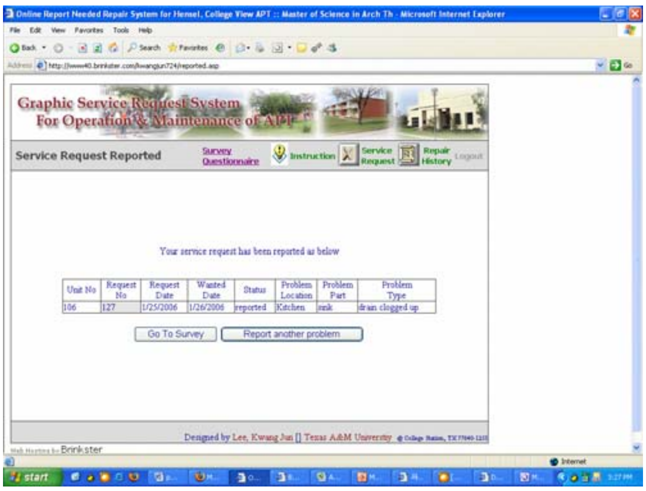

Fig. 13. The resident’s graphic input produces a text-based problem on the fly

3. CONCLUSION AND DISCUSSION

3.1 Evaluation

Through the survey, 53% of residents indicated that they previously encountered communication problems with FM departments or property managers. They hesitated to report issues because of difficulty explaining them, time limitations, or the absence of FM staff. Residents mentioned that FM staffs are unable to prepare and bring the material needed to fix problems sometimes. Recognition of problem correctly in the first place avoids these inefficient and redundant activities. Results from experiments show that all of the residents who log into the system succeeded in requesting services.

The results of the experiment indicate that 70% of occupants prefer to use the WGSR system for reporting and tracking service requests instead of other communication methods such as phone calls. This result indicates that WGSR could decrease the effort involved in placing and receiving phone calls for service requests, as well as the subsequent input of information into a database. As information and Internet technology has advanced, people have begun to request services through the Internet anywhere and anytime with personal computers. Information and Internet technology makes it possible for everyday services and requests to be automated and to minimize human intervention. There are no other service request systems using graphical interfaces at present. This system addresses the disadvantage of the text-based service request systems which needs information to be input manually. The analysis of the results shows that the WGSR system was efficient and convenient in several fields which include comprehensibility, navigability, simplicity, clarity, compatibility, and graphically appealing.

The evidence verifies that one can establish, develop, and implement a Web-based graphic service request system for improving FM. Combination of location, part, and types of problem ID set one service request record. This could simplify the explanation of problems associated with phone calls or walk ins. The maintenance database was centralized and efficiently used over the network. The result of the survey validate that graphic service requests could popularize the WGSR system for customer use.

Supporting an easy-to-use customer interface is important to promote the frequency of system use for service requests. Unifying the reporting process into one application improves the quality of data and response time for service requests. Initial requests from residents were recorded directly and this prohibits the drop of recording information from phone calls and missing information from transferring data. It improves the quality of information and communication between residents and FM organizations.

3.2 Further Discussion

The scope of this research is to present and demonstrate the concept of a graphic service request system for residents to use. Graphic service requests are recorded text-based style to the FM organization on the fly. To improve the system for use in real facility management organizations, it should be decided whether service requests are showed in a graphic-based or text-based fashion to FM staff. To determine resident's service request patterns and deliver better service, a large number of participants and data are essential to conclusively demonstrate the usefulness of the WGSR system.

Likewise, the system was implemented only for the test of residents. To maximize the system, it should be tested from the point of view of FM staff. Such testing would target all parties involved in using the WGSR system, thereby indicating the feasibility of the system for both residents and staff.

The floor plan used in the WGSR system could be substituted by a real photo image or a 2D image with HTML image tags. Therefore, it could be used in any type of building; this is especially useful for apartments, hospitals, and offices where the same type of unit plan is repeated within the structure.

Although users prefer to use the WGSR system for service requests, they still need to use the telephone to report emergencies, etc. Such service requests are possibly too urgent to depend on a Web-based system for a quick response. Therefore, further research investigations into the system should integrate information from multiple communication methods into a single database which can recognize emergency situations using information retrieval algorithms or artificial intelligence in order to notify FM staff quickly so they can respond appropriately.

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